International
IOR Rectifier

December, 10th 2011
Automotive grade

AUIPS6044G

INTELLIGENT POWER HIGH SIDE SWITCH

Features

- Over temperature shutdown (with auto-restart)
- Short circuit protection (current limit)
- Reverse battery protection (turns On the MOSFET)
- Full diagnostic capability (short circuit to battery)
- Active clamp
- Open load detection in On and Off state
- Ground loss protection
- Logic ground isolated from power ground
- ESD protection

Product Summary

Rds(on)	130mΩ max.
Vclamp	39V
I Limit	7A
Open load	3V / 0.22A

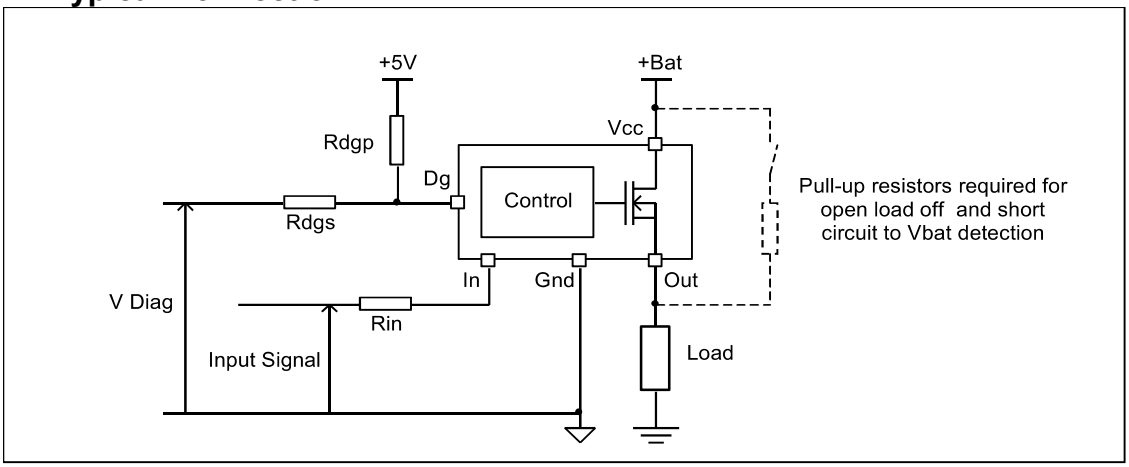
Package

SOIC28 Wide body

Description

The AUIPS6044G is quad output Intelligent Power Switch (IPS) for use in a high side configuration. It features short circuit, over-temperature, ESD protection, inductive load capability and diagnostic feedback. The output current is limited to the Ilim value. The current limitation is activated until the thermal protection acts. The over-temperature protection turns off the device if the junction temperature exceeds the Tshutdown value. It will automatically restart after the junction has cooled 7°C below the Tshutdown value. The reverse battery protection turns On the MOSFET. A diagnostic pin provides different voltage levels for each fault condition. The double level shifter circuitry will allow large offsets between the logic and load ground.

Typical Connection



Qualification Information†

Qualification Level		Automotive (per AEC-Q100††)	
		Comments: This family of ICs has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		SOIC-28L	MSL2, 260°C (per IPC/JEDEC J-STD-020)
ESD	Machine Model	Class M2 (+/-150V)††† (per AEC-Q100-003)	
	Human Body Model	Class H1C (+/-1500V)††† (per AEC-Q100-002)	
	Charged Device Model	Class C4 (+/-900V)††† (per AEC-Q100-011)	
IC Latch-Up Test		Class II, Level A (per AEC-Q100-004)	
RoHS Compliant		Yes	

† Qualification standards can be found at International Rectifier's web site http://www.irf.com/
†† Exceptions to AEC-Q100 requirements are noted in the qualification report.
††† Passing voltage level

Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Ground lead. Tj= -40°C..150°C, Vcc=6..35V (unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vout	Maximum output voltage	Vcc-35	Vcc+0.3	V
Voffset	Maximum logic ground to load ground offset	Vcc-35	Vcc+0.3	
Vin	Maximum input voltage	-0.3	5.5	
Vcc max.	Maximum Vcc voltage	—	36	
Vcc cont.	Maximum continuous Vcc voltage	—	28	
Iin max.	Maximum IN current	-3	10	mA
Idg max.	Maximum diagnostic output current	-3	10	
Vdg	Maximum diagnostic output voltage	-0.3	5.5	V
Pd	Maximum power dissipation (internally limited by thermal protection) Rth=130°C/W per channel	—	3.8	W
Tj max.	Max. storage & operating temperature junction temperature	-40	150	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
Rth1	Thermal resistance junction to ambient 1" sqrt. Footprint / 1 channel On	50	—	°C/W
Rth2	Thermal resistance junction to ambient 1" sqrt. Footprint / 2 channels On	100	—	
Rth3	Thermal resistance junction to ambient 1" sqrt. Footprint / 4 channels On	130	—	

note : Tj=Power dissipated in one channel x Rth

Recommended Operating Conditions

These values are given for a quick design. For operation outside these conditions, please consult the application notes.

Symbol	Parameter	Min.	Max.	Units
VIH	High level input voltage	4	5.5	
VIL	Low level input voltage	0	0.9	
Iout	Continuous drain current, Rth=130°C/W, Tj=150°C, 4 channels On			A
	Tambient=85°C / 1" sqrt. footprint	—	1.5	
	Tambient=105°C / 1" sqrt. footprint	—	1.2	
Rin	Recommended resistor in series with IN pin	4	10	kΩ
Rdgs	Recommended resistor in series with DG pin for reverse battery protection	4	20	
Rdgp	Recommended pull-up resistor for DG	4	20	
Rol	Recommended pull-up resistor for open load detection	5	100	
F max.	Max. switching frequency	—	3.5	kHz

Static Electrical Characteristics

Tj=-40°C..150°C, Vcc=6..28V (unless otherwise specified), typical values are given for Vcc=14V and Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance Tj=25°C	—	110	130	mΩ	Vin=5V, Iout=2.5A
	ON state resistance Tj=150°C(1)	—	190	230		Vin=5V, Iout=2.5A
	ON state resistance Tj=25°C, Vcc=6V	—	125	155		Vin=5V, Iout=1.5A
	ON state resistance during reverse battery Tj=25°C	—	140	180		Vcc-Gnd=-14V
Vcc op.	Operating voltage range	6	—	28	V	
V clamp 1	Vcc to Out clamp voltage 1	37	39	—		Iout=20mA
V clamp 2	Vcc to Out clamp voltage 2	—	40	—		Iout=2.5A (see Fig. 1)
Icc Off	Supply current when Off and Vout connected to ground with R<4Ω	—	4	9	µA	Vin=0V, Vout=0V, Tj=25°C, Vcc=14V
Icc On	Supply current when On	—	2.2	5	mA	Vin=5V, Vcc=14V
Vih	Input high threshold voltage	—	2.5	3	V	
Vil	Input low threshold voltage	1.5	2	—		
In hyst.	Input hysteresis	0.2	0.5	1		
Iin On	Input current when device is On	—	40	100	µA	Vin=5V
Idg	Dg leakage current	—	0.1	10		Vdg=5V
Vdg	Low level DG voltage	—	0.25	0.4	V	Idg=1.6mA

Switching Electrical Characteristics

Vcc=14V, Resistive load=6Ω, Vin=5V, Tj=-40°C..150°C, typical values are given for Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn-on delay time	—	5	15	µs	see Fig. 3
Tr1	Rise time to Vout=Vcc-5V	—	3	10		
Tr2	Rise time to Vout=0.9 x Vcc	—	4	30		
dV/dt (On)	Turn On dV/dt	—	2.5	—	V/µs	
EOn	Turn On energy	—	100	—	µJ	
Tdoff	Turn-off delay time	—	10	20	µs	
Tf	Fall time to Vout=0.1 x Vcc	—	3	10		
dV/dt (Off)	Turn Off dV/dt	—	6.5	—	V/µs	
EOff	Turn Off energy	—	50	—	µJ	

Protection Characteristics

Tj=-40°C..150°C, Vcc=6..28V (unless otherwise specified), typical values are given for Vcc=14V and Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ilim	Internal current limit	4	7	10	A	Vout=0V, Tj=25°C
Tsd+	Over temperature high threshold	150(1)	165	—	°C	See fig. 2
Tsd-	Over temperature low threshold	—	158	—		
Vsc	Short-circuit detection voltage(2)	2	3	4	V	
UV+	Under voltage protection Vcc going up	—	5	6.2		
UV-	Under voltage protection Vcc going down	—	4.5	5.8		
VOL Off	Open load detection threshold	2	3	4		
I OL On	Open load detection threshold	0.05	0.17	0.27	A	Tj=-40..25°C
		0.05	0.15	0.22		Tj=25..150°C

(1) Guaranteed by design
(2) Reference to Vcc

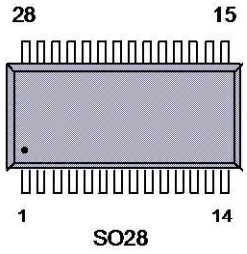
True Table

Operating Conditions	IN	OUT	DG
Normal	H	H	H
Normal	L	L	H
Open Load	H	H	L
Open Load (3)	L	H	L
Short circuit to Gnd	H	L	L
Short circuit to Gnd	L	L	H
Short circuit to Vcc	H	H	L (4)
Short circuit to Vcc (5)	L	H	L
Over-temperature	H	L	L
Over-temperature	L	L	H

(3) With a pull-up resistor connected between the output and Vcc.
(4) Vds lower than 10mV.
(5) Without a pull-up resistor connected between the output and Vcc.

Lead Assignments

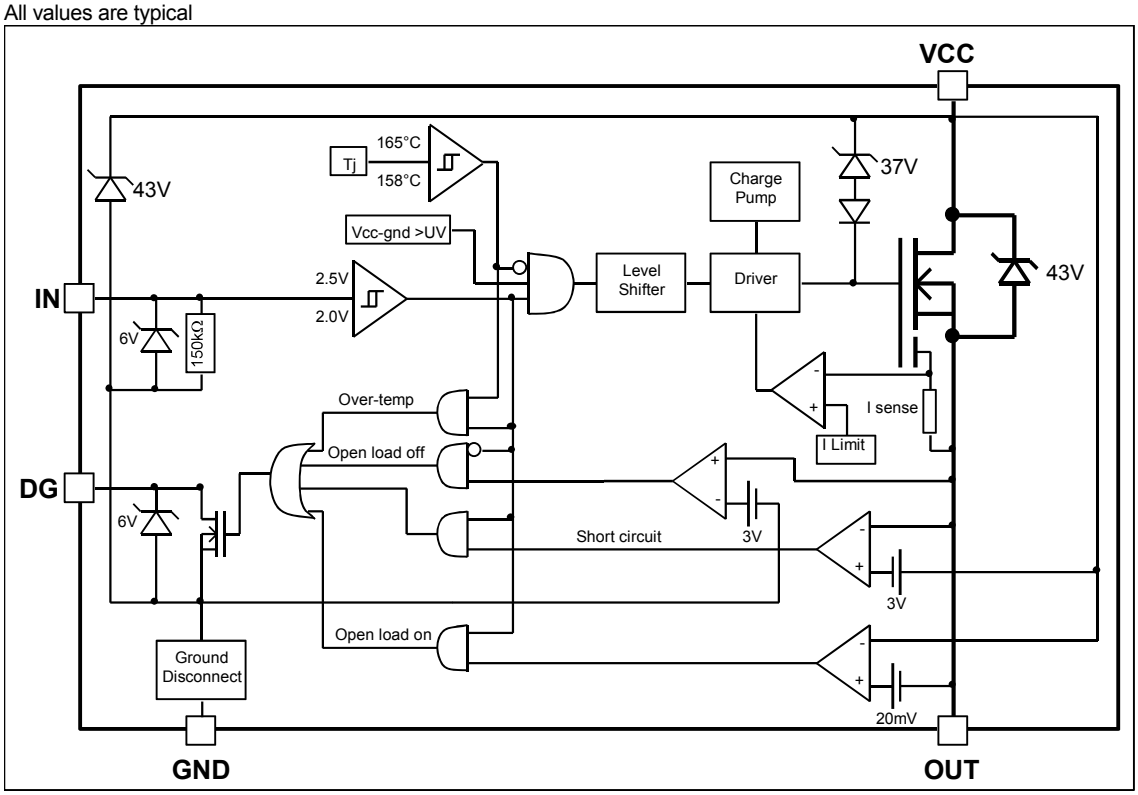
1- Vcc	15- Vcc
2- GND1	16- OUT4
3- IN1	17- OUT4
4- DG1	18- OUT4
5- DG2	19- OUT3
6- IN2	20- OUT3
7- GND2	21- OUT3
8- GND3	22- OUT2
9- IN3	23- OUT2
10- DG3	24- OUT2
11- DG4	25- OUT1
12- IN4	26- OUT1
13- GND4	27- OUT1
14- VCC	28- Vcc



SO28

Functional Block Diagram

All values are typical



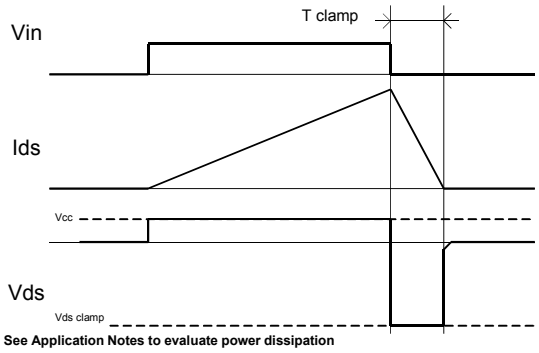


Figure 1 – Active clamp waveforms

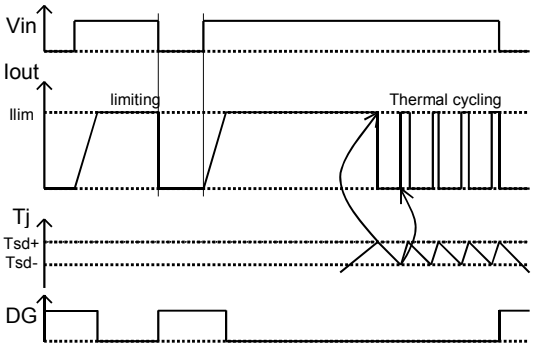


Figure 2 – Protection timing diagram

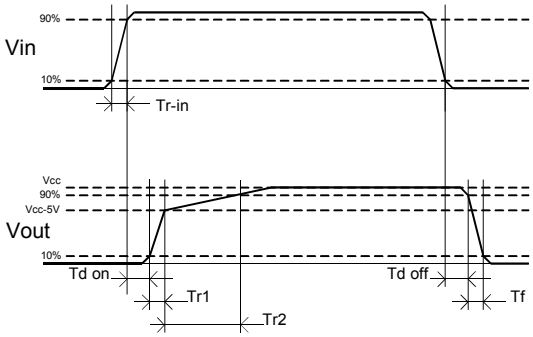


Figure 3 – Switching times definitions

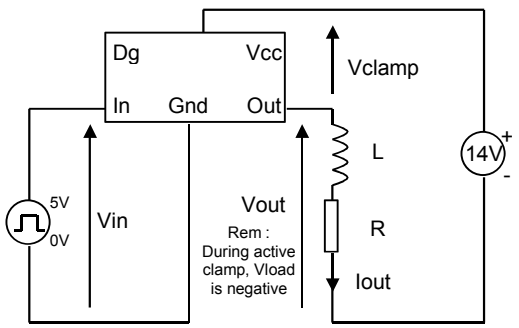


Figure 4 – Active clamp test circuit

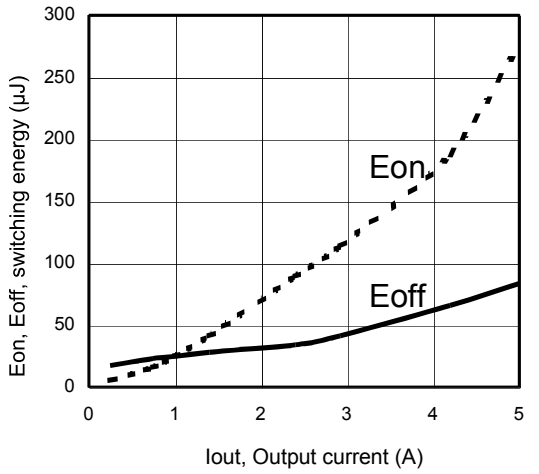


Figure 5 – Switching energy (µJ) Vs Output current (A)

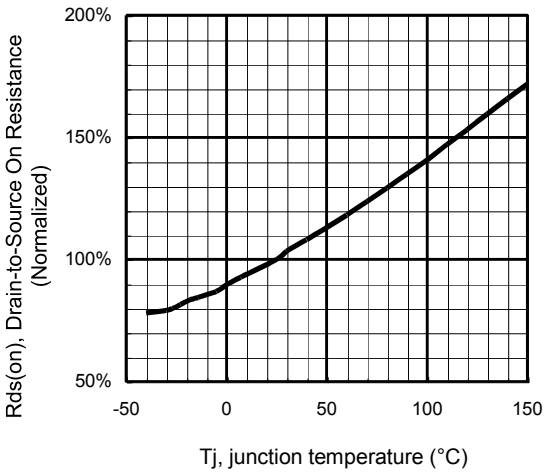


Figure 6 - Normalized Rds(on) (%) Vs Tj (°C)

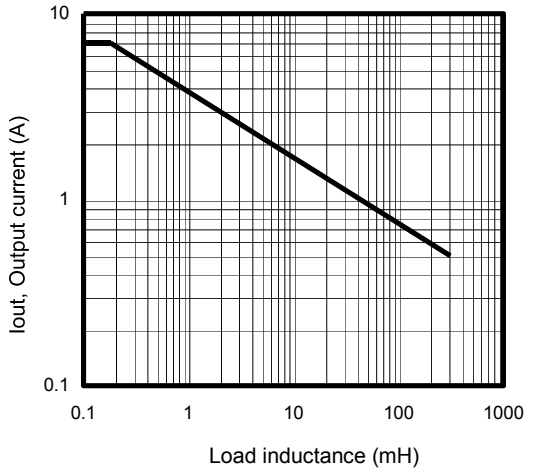


Figure 7 – Max. Output current (A) Vs Load inductance (mH)

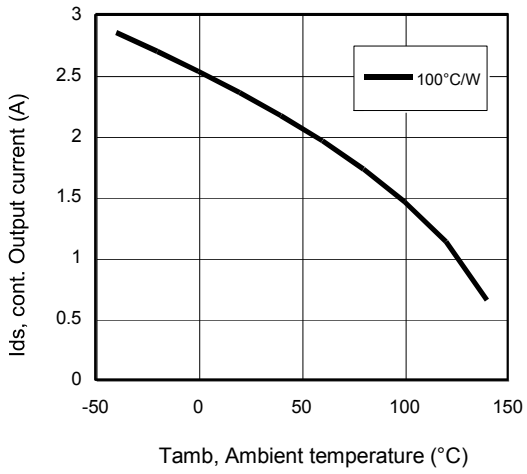


Figure 8 – Max. ouput current (A) Vs Ambient temperature (°C)

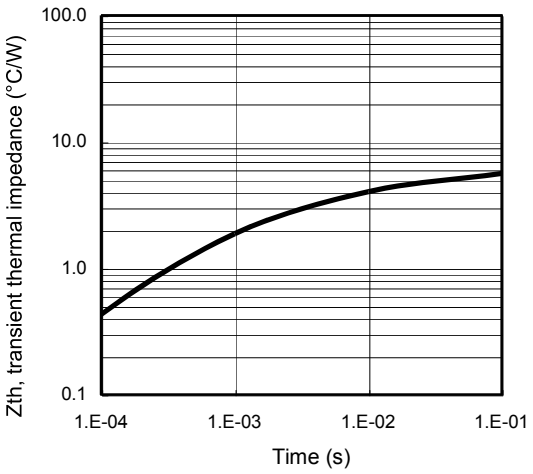


Figure 9 – Transient thermal impedance (°C/W) Vs time (s)

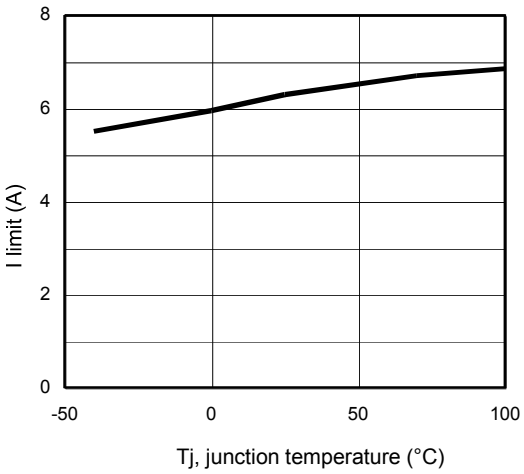


Figure 10 –I limit (A) Vs junction temperature (°C)

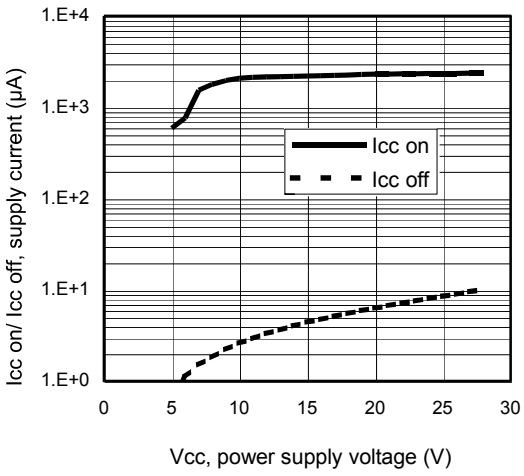


Figure 11 – Icc on/ Icc off (µA) Vs Vcc (V)*

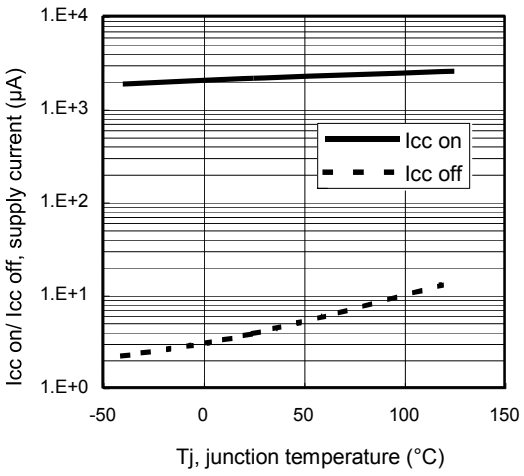
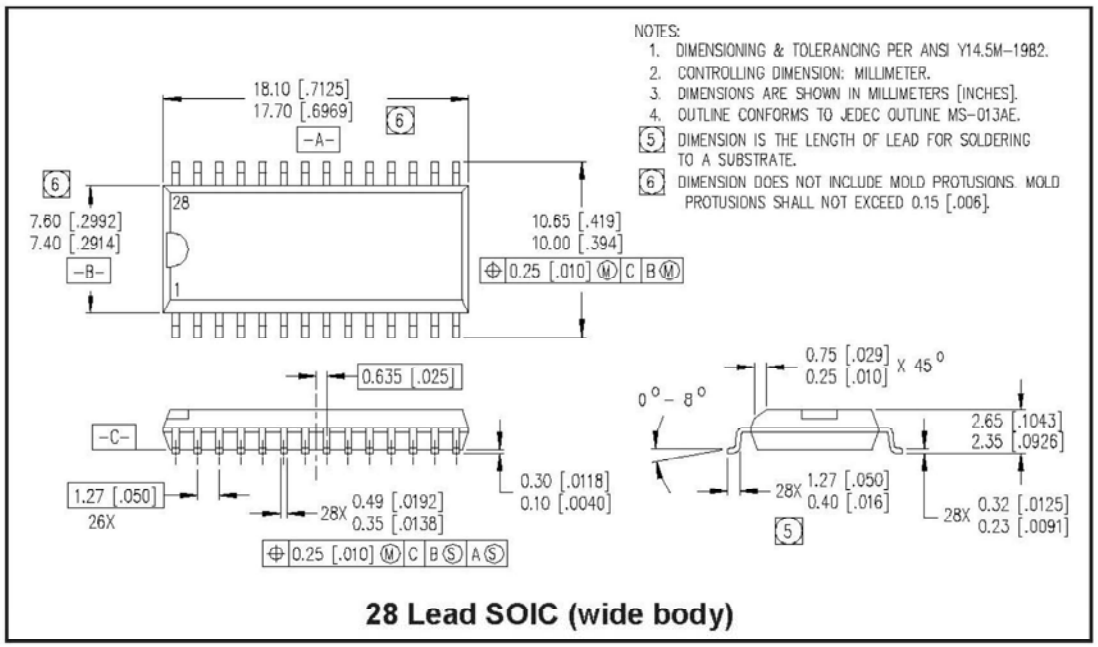


Figure 12 – Icc on/ Icc off (µA) Vs Tj (°C)*

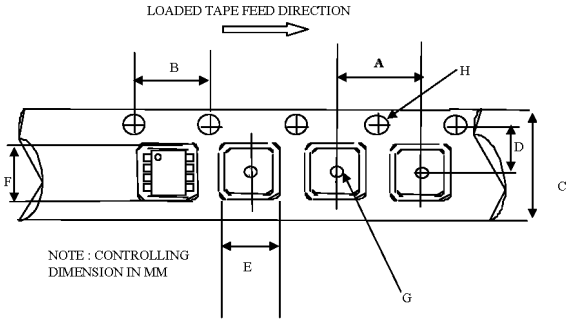
*Vout connected to ground with R<4Ω

Case Outline – SO28



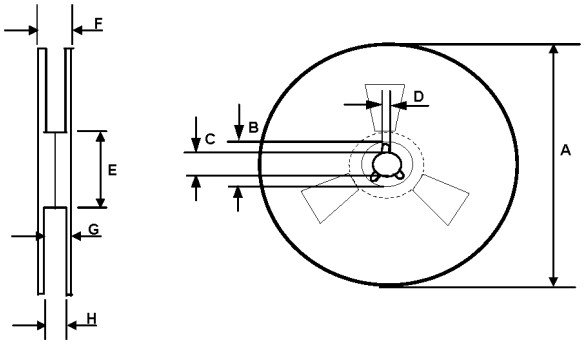
28 Lead SOIC (wide body)

Tape & Reel – SO28



CARRIER TAPE DIMENSION FOR 28SOICW

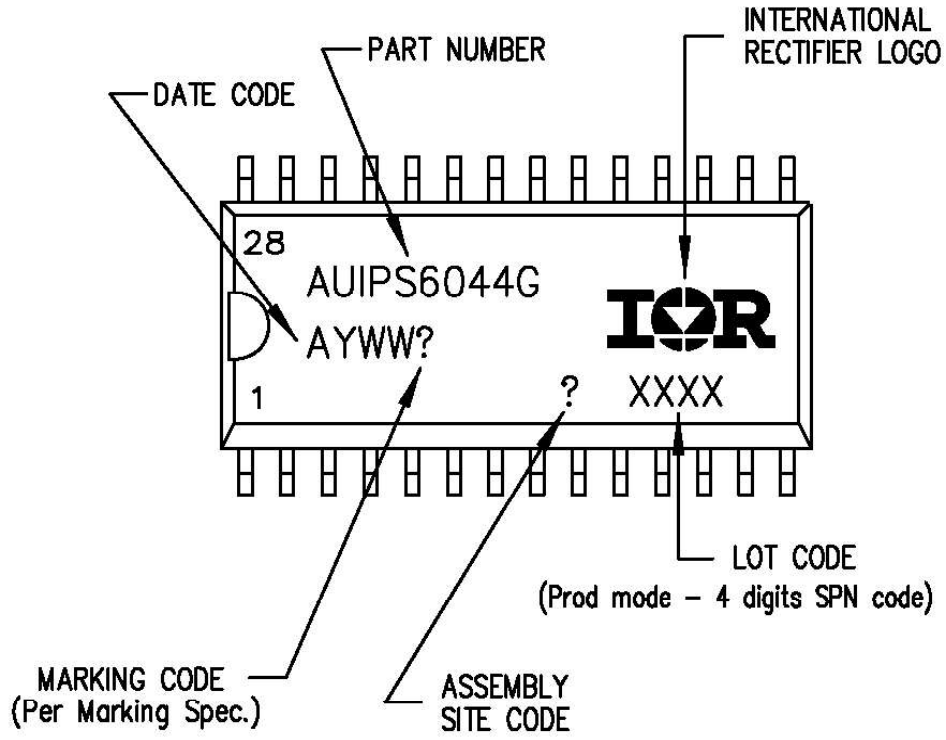
	Metric		Imperial	
Code	Min	Max	Min	Max
A	11.90	12.10	0.468	0.476
B	3.90	4.10	0.153	0.161
C	23.70	24.30	0.933	0.956
D	11.40	11.60	0.448	0.456
E	10.80	11.00	0.425	0.433
F	18.20	18.40	0.716	0.724
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 28SOICW

	Metric		Imperial	
Code	Min	Max	Min	Max
A	329.60	330.25	12.976	13.001
B	20.95	21.45	0.824	0.844
C	12.80	13.20	0.503	0.519
D	1.95	2.45	0.767	0.096
E	98.00	102.00	3.858	4.015
F	n/a	30.40	n/a	1.196
G	26.50	29.10	1.04	1.145
H	24.40	26.40	0.96	1.039

Part Marking Information



Ordering Information

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIPS6044G	SOIC-28	Tube	30	AUIPS6044G
		Tape and reel	1000	AUIPS6044GTR

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http://www.irf.com/technical-info/

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Revision History

Revision	Date	Notes/Changes
B2	September, 12th 2011	AU release
B3	December, 10th 2011	Update qualification page
C	May 15, 2012	Add the test condition for the ICC (off) parameters